

SR3 / SR104 / SR303 / SR307 / SR308 Kitsap County

2.16 Illumination

2.16.1 General

The Design-Builder shall perform all Work necessary to meet the requirements for temporary and permanent illumination for the Project, including the required illumination specified in Section 1040 of the WSDOT *Design Manual*, and as specified in this Section.

2.16.2 Mandatory Standards

The following is a list of Mandatory Standards that shall be followed for all design and construction related to this Section as referenced in Section 2.2, *Mandatory Standards*.

1. WSDOT ***\$1\$*** *Electrical Special Provisions* (Appendix 4)
2. Special Provisions (Appendix 4)
3. Standard Specifications M 41-10 (Appendix 4)
4. WSDOT ***\$2\$*** *Current Practices in Electrical Design* (Appendix 4)
5. WSDOT *AGi32 Basics for WSDOT Highway Lighting* (Appendix 4)
6. WSDOT *Design Manual* M 22-01 (Appendix 4)
7. WSDOT *Draft Power System Design* (Appendix 4)
8. Standard Plans M 21-01 (Appendix 4)
9. WSDOT *Materials Manual* M 46-01 (Appendix 4)
10. WSDOT *Construction Manual* M 41-01 (Appendix 4)
11. WSDOT ***\$3\$*** *Illumination and Signal Details* (Appendix 4)
12. WSDOT *Plans Preparation Manual* M 22-31 (Appendix 4)
13. WSDOT *Maintenance Manual* M 51-01 (Appendix 4)
14. WSDOT *Bridge Design Manual LRFD* M 23-50 (Appendix 4)
15. *NFPA 70: National Electric Code* (NEC)
16. *AASHTO A Policy on Geometric Design of Highways and Streets*
17. *AASHTO Roadside Design Guide*
18. *IESNA American National Standard Practice for Roadway Lighting* (ANSI/IES RP-8-18)
19. *Service Agreement Request Checklist* (Appendix U)

2.16.3 *Design and Construction Requirements*

2.16.3.1 Software

The Design-Builder shall use the most current AGI32 Lighting Design Software, available from Lighting Analysts, Inc., Littleton, Colorado, 303-972-8852. The software shall use data files in Illuminating Engineering Society (IES) standard format for the luminaires. Lighting analysis shall be submitted to WSDOT electronically in both PDF and AGI file formats.

2.16.3.2 Traffic Task Force Meetings

The Design-Builder shall establish a Traffic Task Force to oversee and provide input on the design and construction of traffic-related design issues including, but not limited to, traffic signals, signing, lighting, pavement marking, and Intelligent Transportation Systems (ITS). The Design-Builder shall schedule and chair the meetings during the design and construction stages until Substantial Completion. The Design-Builder shall prepare the agenda, meeting minutes, exhibits, and Design Plans necessary for each meeting. Meetings shall include representatives from WSDOT, Local Agencies ***determined during phase 1***, and other representatives as requested by WSDOT.

2.16.3.3 WSDOT Electrical Inspector

The Washington State Department of Labor and Industries has authority over all electrical installations within the State. WSDOT has been granted authority over all electrical installations within the Right of Way of State highways, provided WSDOT maintains and enforces an equal, higher, or better standard of construction, materials, devices, appliances, and equipment than is required by Applicable laws. It is the role of the WSDOT Electrical Inspector to ensure that all electrical installations, including Illumination, Traffic Signal, and ITS installations, meet the requirements of the National Electric Code, and Applicable Laws and provisions.

The WSDOT Electrical Inspector will perform the following:

- Act as a resource for the electrical design team
- Assist with electrical plan reviews (as applicable)
- Perform periodic electrical inspections during construction
- Witness required field tests (as desired)
- Perform inspections required before energizing any new equipment or circuits
- Inspect and approve all electrical installations in accordance with this Contract.

2.16.3.4 Permanent Lighting Design Requirements

The Design-Builder shall provide illumination at all locations identified as required illumination in Chapter 1040 of the WSDOT *Design Manual*, Code of Federal Regulations (14 CFR) Part 77, and as specified in these Technical Requirements (TR). The Design-Builder shall use the light levels, veiling luminance, and uniformity ratios presented in the WSDOT *Design Manual*, including the appropriate area classification.

All existing equipment including light standards, junction boxes, and conductors that are not required by the TR shall be disconnected from the permanent lighting system and shall be removed. Existing equipment that is removed including, but not limited to, light standards, light standard slip bases, cabinets, lamps, and luminaire fixtures shall be salvaged in accordance with this Section. Removed equipment shall not be reused for the permanent illumination system, except where allowed in this Section.

Existing light standards scheduled for removal shall also include the complete removal of the existing foundation, conduit sweeps, associated junction box, and all wiring. Existing conduits can be abandoned in place after the removal of wiring and conduit elbows.

The allowable line loss and minimum allowable wire size for illumination systems shall be in accordance with the WSDOT Draft Power System Design manual (Appendix T).

The Design-Builder shall not place light standards behind walls. Light standards shall be placed to facilitate maintenance accessibility and minimize exposure to vehicles. Associated junction boxes placed in structures and walls shall face the traveled way.

The Design-Builder shall design and construct the illumination system to accommodate future maintenance. Luminaires shall be located such that they can be accessed by the WSDOT maintenance ***\$\$as determined during phase 1\$\$***. Typical WSDOT maintenance bucket truck reach is included in Appendix 4.

The Design-Builder shall provide illumination when required in accordance with these TR. The illumination system design shall use the lowest wattage luminaires and the least number of luminaires necessary to meet the light level requirements of the WSDOT *Design Manual*.

Local road lighting shall be designed and constructed in accordance with Local Agency standards. Local roadway lighting meeting this requirement shall be connected to a non-WSDOT electrical service meeting the requirements of the Local Agency.

2.16.3.4.1 Photometric Analysis

The Design-Builder shall complete a photometric analysis that includes the following:

- Lighting intensities (foot candles) and uniformity (average/minimum); light pole locations and fixture mounting heights; luminaire types; wattage; and quantities of each.
- Lighting calculations for WSDOT lighting systems shall use High Pressure Sodium (HPS) luminaires and use the lamp lumen depreciation and lamp dirt depreciation values described in the AGi32 Basics for WSDOT Highway Lighting (Appendix T). This establishes the wattage class for selecting LED luminaires for installation.
- Lighting calculations using photometric files specifically, including the effect of light shields when light shields are required as specified in this Section.
- Lighting contours for nighttime illumination shall show the distances from the light source at lighting levels 1.0, 0.5, and 0.2 foot-candle. Lighting contours of 0.1 and 0.05 foot-candle shall be provided for permanent surfaces adjacent to sensitive areas such as streams and rivers. Topographic plan features shall be shown at least 150 feet beyond the illumination contours.
- Lighting calculation grid spacing shall be 5 by 5 feet.
- Veiling luminance calculations

A surface shall be created for each lighting design area that matches the roadway contours.

Photometric analysis for temporary illumination may be performed using the specific temporary luminaire(s) selected by the Design-Builder.

2.16.3.4.2 Ceiling or Wall-Mounted Luminaires

This section was intentionally omitted.

2.16.3.4.3 Spillover Light

When adjacent to non-commercial areas, the maximum spillover light allowed shall be 0.2-foot candles at ground level at the edge of the Right of Way (ROW), unless otherwise noted. The Design-Builder shall install light fixtures with backlight control to limit spillover light outside of the ROW. Temporary lights for night work will be directed away from waters with listed fish species to the greatest extent possible, with the intent to prevent light from shining on surface waters. When permanent lighting is needed on a bridge or road segment adjacent to surface waters with listed fish species, individual light fixtures with cutoff optics and light shields will be used to minimize spillover light, rather than area lights that illuminate larger areas. Lights will be directed away from waters with listed fish species to the extent possible. Walkways and bicycle lanes on bridges will be lit at grade level, if possible, to minimize nighttime light exposure of waters with listed fish species.

2.16.3.4.4 *Specific Requirements*

The Design-Builder shall provide the following illumination:

- *** determined during phase 1 ***

2.16.3.4.4.1 **Light Standards and Foundations**

Light standards shall conform to the Standard Plans and the following:

- Light standards shall also meet the following requirements:
 - Top of barrier installation - base plates shall be modified to conform to the dimensions shown in the Standard Plans.
 - Additional requirements as determined during phase.
- Light standards along ***locations determined during phase 1 *** shall be in accordance with the ***local jurisdiction standards as determined during phase 1 ***.
- All openings shall be installed during fabrication. All openings in the pole shall have a water-tight, gasketed cover attached with stainless steel box bolts.
- No field welding will be permitted.
- The design of the light standard shall comply with the pre-approved shop drawings in accordance with the Special Provisions.
- Where pre-approved light standards are not used, light standards shall be designed in accordance with the WSDOT *Standard Specifications* and Section 2.13, *Bridges and Structures*.
- The Design-Builder shall perform a geotechnical analysis for each light standard location to determine the appropriate design criteria for light standard foundations, in accordance with Section 2.6, *Geotechnical*. The geotechnical analysis shall include lateral bearing pressure, friction angle, and water table values at each light standard location and shall be submitted as part of the Preliminary Permanent Illumination Plans. Where Standard Plan foundations cannot be used, foundations shall be designed in accordance with Section 2.6, *Geotechnical*.

Where light standards are to be installed on structures, supports shall be designed in accordance with Section 2.13, *Bridges and Structures*.

Complete calculations for light standard structural design shall be prepared and submitted to WSDOT.

2.16.3.4.4.2 **Luminaires**

The Design-Builder shall furnish and install LED type fixtures for all new luminaires mounted on light standards considered part of a WSDOT lighting system. Underdeck and wall-mounted lights shall be LED-type fixtures.

All LED fixtures of a particular form (cobra-head, wall mount, etc.) shall be from the same manufacturer. LED luminaires for WSDOT systems shall be selected

1 from the list of pre-approved LED Conventional Roadway Luminaires as
2 described in WSDOT Standard Specification 9-29.10(1) B.
3 Luminaires shall be positioned above the fog line, within 2 feet lateral distance of
4 the fog line.
5 Luminaires installed on Local Agency facilities shall follow the Local Agency
6 standards.

7 **2.16.3.4.5 Equipment Provided by WSDOT**

8 The Design-Builder shall supply all equipment except for the following:
9 *** determined during phase 1***.

10 **2.16.3.5 Permanent Illumination Construction Requirements**

11 Illumination systems shall remain operational at all times during construction
12 unless a temporary illumination system is provided to cover the affected area. All
13 damage to illumination systems shall be repaired prior to hours of darkness on the
14 following day.

15 Existing illumination systems to be replaced on the Project shall remain
16 operational until new or temporary illumination systems are installed, tested, and
17 fully operational. The Design-Builder shall notify WSDOT 14 Calendar Days
18 prior to removing existing illumination systems or disrupting power to any
19 illumination system.

20 All lighting conductors shall be installed using conduits containing only electrical
21 conductors. New conduit and junction box systems shall be separated from traffic
22 signal conduits and ITS communication conduits. A shared trench, shared power
23 source, and shared cabinet foundations may be used.

24 Each ramp lighting system shall be assigned a separate lighting circuit. A
25 minimum of two lighting circuits shall be assigned to each ramp terminal lighting
26 system. Ramp lighting circuits may be used for ramp terminal lighting as long as
27 a minimum of two circuits are provided for ramp terminal lighting.

28 Light standards shall be installed a minimum of 50 feet from sign bridge
29 structures and other structures that might impede or distort the light distribution
30 on the highway. Existing light standards located within 50 feet from a new sign
31 structure or other structure that impedes or distorts the lighting on the traveled
32 way shall be removed; and a new light standard shall be installed at a location that
33 meets all lighting requirements for light levels, uniformity, and veiling luminance.

34 The Design-Builder shall coordinate with the Utility company to determine the
35 separation between overhead Utilities and new or existing illumination structures.
36 A minimum of 10 feet of circumferential clearance to all power lines including
37 the neutral shall be maintained. A greater clearance may be required for higher
38 voltages in accordance with the local Utility company's requirements.

39 The Design-Builder shall perform the required testing for temporary and
40 permanent illumination and electrical systems in accordance with the Special

Provisions and the Standard Specifications. The Design-Builder shall incorporate all testing into the Baseline Contract Schedule and Monthly Contract Schedule Updates for submittal to WSDOT. The Design-Builder shall submit all testing procedures, pass/fail requirements, manufacturer's certification of compliances, and equipment documentation to WSDOT for Review and Comment and resolve all WSDOT comments a minimum of 14 Calendar Days prior to any testing. The Design-Builder shall submit test reports upon completion of each test in accordance with this Section and Section 2.28, *Quality Management Plan*. WSDOT may observe any tests and will audit test results. The Design-Builder shall notify WSDOT when all illumination and electrical requirements have been met in accordance with the Contract, including training, documentation, testing, and field installations. WSDOT will perform the final electrical inspection and acceptance of illumination systems in accordance with Washington Administrative Code 296-46B-010 upon Physical Completion.

When an existing bridge or wall requires placement of light standards, the Design-Builder may mount the light standard on the bridge or on the wall if the structure is adequate for the additional loads. The height of the light standard shall be specified to maintain the required luminaire height above the roadway. The Design-Builder shall provide calculations indicating that the bridge or wall (existing or new) is adequate for the additional loads.

Light standard foundations shall not be located in ditches and shall be placed to minimize vehicle collisions.

2.16.3.5.1 Maintenance and Operation

Lighting must be maintained operational for all design areas required by the WSDOT *Design Manual*. Existing permanent, new permanent or temporary lighting systems may be used for this purpose.

The Design-Builder shall provide maintenance and conduct repairs for all lighting within the Project Limits until Physical Completion. For systems that are partially located within the Project Limits, the Design-Builder shall coordinate with the WSDOT regional Signal and ITS Maintenance Supervisor/Superintendent regarding the division of maintenance responsibilities for those systems.

Maintenance of lighting is defined as performing the work necessary to maintain required lighting operational, including providing and replacing lamps and responding to and correcting electrical outages. Maintenance of lighting also includes performing locates for all equipment for which the Design-Builder has maintenance responsibility. WSDOT will perform the first set of locates requested by the Design-Builder for existing systems – refresh requests are the responsibility of the Design Builder.

2.16.3.5.2 Temporary Illumination Construction Requirements

Temporary illumination system(s) shall be designed and installed when required in accordance with this Section and Section 2.22, *Maintenance of Traffic*. Temporary lighting systems shall be modified, adjusted, or relocated in order to

1 accommodate the Released for Construction (RFC) Traffic Control Plans, Staging
2 Plans, order of Work, and detours. After the permanent lighting system is
3 energized and made operational, the temporary lighting system shall be
4 completely removed. All poles, temporary wiring, junction boxes, conduit
5 sweeps, and cabinets shall be removed. Holes and voids shall be backfilled.

6 Temporary illumination shall meet all the TR for light levels, veiling luminance,
7 and uniformity ratios presented in the WSDOT *Design Manual* for permanent
8 illumination.

9 **2.16.3.5.3 Electrical Service, Transformers, and Cabinets**

10 The Design-Builder shall coordinate with WSDOT and submit the design
11 calculations, including peak/continuous loads, breaker, and contactors sizing
12 calculations for new and modified electrical services.

13 Electrical service cabinets for Local Agencies' electrical systems shall not be
14 located within limited access ROW unless otherwise approved by WSDOT.

15 Underground service laterals (conduit and conductors) shall be provided by the
16 Design-Builder between the Utility power source and the service cabinet. Service
17 laterals, from the Utility company transformer to the service cabinet, shall be
18 isolated from other circuits by using a separate conduit. Junction boxes in this
19 conduit run are not allowed. Electrical service connections shall meet Utility
20 company requirements.

21 The Design-Builder shall coordinate the placement of electrical services so that
22 circuits from the service do not overlap or cross paths with circuits from other
23 services. The circuits from respective services shall be separated geographically
24 so that the electrical systems of one service do not cover the same section of
25 roadway as another service.

26 The main breaker size for electrical services shall be a minimum of 200 amps.
27 Branch breakers shall be sized in accordance with the WSDOT Draft Power
28 System Design manual (Appendix T). Spare illumination branch breakers shall
29 be rated at 20A.

30 The service lateral conductors shall be sized to serve the full load capacity of the
31 service main breaker.

32 Lighting contactors shall be rated equal to or greater than the branch breaker
33 rating for the same circuit.

34 All ITS, ramp meters, and traffic signal cabinets shall be powered from individual
35 branch breaker circuits in the directly supplying service or transformer cabinet.
36 Multiple cabinets shall not be connected to the same supplying branch circuit
37 breaker.

38 Electrical services shall include all branch breakers and contactors detailed in the
39 applicable Standard Plan wiring schematics. Breakers and contactors not utilized
40 shall be labeled as spares.

All WSDOT cabinets shall provide sufficient access from the ROW and shall not be installed in ditches or on slopes steeper than 4H:1V (Horizontal to Vertical).

All WSDOT cabinets shall be constructed so that a level, 3.5 feet clear space around the cabinet foundation exists on all sides for WSDOT access, except that the 3.5 feet of clear space is only required on two sides if the cabinet is located in a ROW fence line.

Transformers shall be installed in separate standalone cabinets. They may share a common pad or foundation with other cabinets. Wires providing power to a transformer cabinet shall be sized to serve the full load capacity rating of the transformer.

Step-up transformers will not be permitted between electrical services and equipment loads.

Transformer sizes shall be standardized at 5, 7.5, 10, 15, or 25 Kilo-Volt-Amps (KVA).

New transformers shall be sized at least 150 percent of the design peak load on the secondary side of the transformer.

When modifying existing transformers by adding additional load, the ultimate peak load shall not exceed 80 percent of the design peak load of the existing transformer.

The design peak load of new transformers and modified existing transformers shall include the maximum potential load of all ground-fault circuit interrupter receptacles located in all equipment cabinets including the transformer cabinet, powered by the transformer.

2.16.3.5.3.1 Electrical Service Agreements

WSDOT will obtain all Electrical Service Agreements from the electric power company. The Design-Builder shall pay all costs charged by the electric power company for the Electrical Service Agreement and for the power company's costs associated with upgrading its facilities to meet the requirements of the Electrical Service Agreement. For all WSDOT electrical services and temporary electrical services powering lighting, traffic signal, and/or ITS equipment, WSDOT will pay the monthly electric bills

The Design-Builder shall coordinate with WSDOT and submit an Electrical Service Agreement Request for all new and modified services required for the Project. The Electrical Service Agreement Request shall include the information listed in the *Service Agreement Request Checklist* and the following:

- Location of existing or new service submitted in plan sheet format
- Load calculations showing design peak loads, design continuous loads, and future loads in KVA and voltage required
- Request for modifications to existing services showing existing load, new load, and ultimate load

- Name of the Utility and the Service Agreement number (for existing services)

The Design-Builder shall submit the Electrical Service Agreement Request a minimum of 90 Calendar Days in advance of when the power connection is needed. WSDOT will begin procurement of the Electrical Service Agreement after the Electrical Service Agreement Request is accepted and determined complete by WSDOT. If changes to the Electrical Service Agreement are required by the Design-Builder, the Design-Builder shall pay all costs associated with the Electrical Service Agreement revisions. The 90 Calendar Day advance notice will begin when the revision to the Electrical Service Agreement Request is accepted and determined complete by WSDOT.

If the Design-Builder proposes to remove an existing service, the Design-Builder shall notify WSDOT in writing at least 14 Calendar Days prior to the proposed removal, so that the service account can be canceled. The written notification shall contain the Service Agreement number, location, and electrical load in KVA.

2.16.3.5.4 *Salvage*

The following illumination equipment shall be salvaged and delivered to the agency designated:

- *** determined during phase 1***

Salvaged equipment shall be delivered to the applicable address below:

*** determined during phase 1***

Fourteen Calendar Days prior to delivery of salvaged items, the Design-Builder shall provide a list of salvage items, their quantity, and their current condition to the WSDOT Region Signal Maintenance Superintendent or applicable agency contact. The Design-Builder shall give a minimum of 7 Calendar Days' notice to the WSDOT Region Signal Maintenance Superintendent or applicable agency contact prior to delivery of salvaged equipment. The Design-Builder shall provide all labor and equipment to transport, load, and unload the salvaged equipment.

2.16.3.5.5 *Conduit System*

The Design-Builder may use existing conduits if the conduit system meets all design requirements.

The Design-Builder shall not saw, cut, or open trenches across the traveled way or paved shoulders.

When the conditions described above are encountered the Design-Builder shall install conduit using jacking, drilling, or boring methods.

A new conduit shall be installed between a new light standard and any other light standard or electrical service.

All conduits shall have a minimum clearance of 3 feet from guardrail posts.

The minimum size conduit for illumination systems is a 2-inch diameter conduit, except a 1-inch diameter conduit shall be used between a light standard and the associated junction box, and a 0.75-inch flex conduit shall be used between an underdeck or wall mounted luminaire and the associated junction box.

Conduits shall be whole inch sizes with the exception of 0.75-inch flex conduit.

Conduit systems for lighting, signals, interconnect, tolling, and ITS systems shall be separated such that each conduit system has separate conduit, pull box, and junction box systems. Conduits may be installed in common trenches and may utilize common power sources.

The Design-Builder shall coordinate the placement of the conduit system with guardrail, noise walls, retaining walls, and Utilities.

The Design-Builder shall install a spare 2-inch conduit associated with every conduit crossing under pavement or through structures, including barriers and walls. The Design-Builder shall install a spare 2-inch conduit between each new electrical service or transformer cabinet and the first junction box.

In new conduits, conductors shall occupy a maximum of 26 percent of the cross-section of the conduit. In existing conduits, conductor fill shall meet NEC requirements for conduit with three or more conductors and shall occupy a maximum of 40 percent of the conduit's cross-sectional area.

The Design-Builder shall install conduit/junction box systems (embedded in concrete) in each of the following newly constructed items:

- Bridge rail
- Median cast-in-place or slip-formed barrier
- Roadside cast-in-place or slip-formed barrier

The conduit/junction box installations shall be constructed in accordance with Section 2.13, *Bridges and Structures*, and the Standard Plans.

Conduit shall not be attached to the outside surface of a newly constructed barrier or bridge rail.

2.16.3.5.6 Junction Boxes, Pull Boxes, and Cable Vaults

Junction boxes, cable vaults, and pull boxes shall not be located within paved shoulders unless no other option is available. Junction boxes, cable vaults, and pull boxes located within paved shoulders shall meet the current Heavy Duty design standard. Existing junction boxes, cable vaults, or pull boxes located in the paved shoulder that do not meet the current Heavy-Duty design standards and are either impacted by the Work or part of a system included in the Work, shall be replaced with boxes that meet the current Heavy Duty design standard. The nearest edge of junction boxes, cable vaults, or pull boxes in the paved shoulder shall be at least 3 feet from the fog line. Existing junction boxes, cable vaults, and pull boxes located in the paved shoulder less than 3 feet from the fog line shall be replaced and located to meet this requirement. The Design-Builder shall consult with WSDOT when considering the installation of Heavy-Duty junction boxes.

When a new barrier or wall section is installed adjacent to a paved shoulder at a junction box location, the junction box shall be a National Electrical Manufacturers Association (NEMA) type junction box installed in the new barrier or wall section. The NEMA box installation shall require the new barrier or wall section to be constructed using the slip form or cast-in-place method. NEMA boxes shall not be attached to the outside of new precast barrier or wall sections.

No junction boxes, cable vaults, or pull boxes shall remain or be placed in the traveled way, ramp, or auxiliary lanes. Existing junction boxes, cable vaults, or pull boxes in the traveled way shall be replaced and relocated to meet the requirements of this Section.

At Substantial Completion there shall be no junction boxes, cable vaults, or pull boxes in the traveled way within the Project limits.

Junction boxes, cable vaults, and pull boxes shall not be located in the sidewalk or walkway unless no other option is available. Junction boxes, cable vaults, and pull boxes installed in the sidewalk shall have skid-resistant covers and shall meet all other Americans with Disabilities Act requirements for placement in sidewalk or walkway. Existing junction boxes, pull boxes, or cable vaults located in sidewalk or paved walkways shall be replaced with skid-resistant junction boxes, pull boxes, or cable vaults.

Junction boxes, cable vaults, or pull boxes shall be installed within 10 feet of each directly connected light standard and within 5 feet of each directly connected cabinet.

The grounding and bonding systems for all existing junction boxes, cable vaults, and pull boxes within the Project limits and scheduled to remain in place shall be repaired and adjusted in accordance with these design requirements. Junction box lids damaged or deformed shall be replaced.

All existing junction boxes, cable vaults, and pull boxes within the Project limits and scheduled to remain in place that do not have locking or bolt down lids shall be replaced.

Additional junction box security requirements to be determined in phase 1.

2.16.3.5.6.1 Junction Boxes

Junction boxes located outside of paved areas shall be Type 1, 2, or 8.

For conduit systems with electrical conductors, junction boxes shall be installed on both sides of each conduit roadway crossing and where conduit makes a 30-degree or greater change in direction.

The maximum spacing for junction boxes in traffic barriers, retaining walls, or structures shall be 200 feet within each raceway system and 300 feet in all other areas.

Junction boxes shall not be used for conduit runs containing fiber optic cable.

1 Junction boxes to be abandoned shall be removed in accordance with the Standard
2 Specifications.

3 Prior to installing conduit or conductors, the Design-Builder shall clean and adjust
4 to grade the existing junction boxes receiving the conduit or conductors.

5 **2.16.3.5.6.2 Pull Boxes**

6 When authorized for use, the maximum spacing for pull boxes in a power
7 distribution run is 750 feet. When transitioning to conventional junction boxes
8 (such as Type 1 junction boxes), the maximum distance between the pull box and
9 the junction box is 200 feet.

10 The Design-Builder shall coil and rack a minimum of 25 feet of each conductor
11 and cable at all pull boxes.

12 **2.16.3.5.7 Utility Locates**

13 Refer to Section 1-07 of the *General Provisions* and Section 2.10, *Utilities, and*
14 *Relocation Agreements* for requirements.

15 **2.16.4 Submittals**

16 The Design-Builder shall submit Preliminary and Final Illumination Plans for
17 Review and Comment and prepare Final Permanent Illumination Plans prior to
18 issuance of the RFC Plans.

19 **2.16.4.1 Preliminary Design Submittal**

20 **2.16.4.1.1 Photometric Analysis**

21 Photometric analysis shall be performed for all illumination areas. The analysis
22 shall identify the mounting height, light standard height (H1), mast arm length,
23 offset, spacing, and lighting fixture data. Photometric data files in IES standard
24 format for the luminaires shall be submitted to the WSDOT Engineer for Review
25 and Comment. The Design-Builder shall provide the following analysis data for
26 the design areas as required by Chapter 1040 of the WSDOT *Design Manual*:

- 27 • Minimum light level
- 28 • Minimum average light level
- 29 • Uniformity ratio (average/minimum)
- 30 • Maximum veiling luminance ratio

31 The Design-Builder shall submit a graphical report showing all design areas with
32 calculation points. The report shall be legible and to scale, and shall list all
33 photometric files, luminaire definitions, and their characteristics. The Design-
34 Builder shall also submit a rendering for each lighting area requiring 3D lighting
35 analysis.

36 The Design-Builder shall submit an electronic copy of the photometric analysis
37 (in AGI32 format) to the WSDOT Engineer with the Preliminary Design
38 Submittal for Review and Comment.

2.16.4.1.2 *Plans*

The Permanent Illumination Plans shall be prepared in accordance with the ***\$1\$***, the photometric analysis, and the WSDOT *Plans Preparation Manual*. The Plans shall include, at a minimum, the following items:

- Existing Utilities
- Proposed channelization
- Location of light standards, service cabinets, conduit, and junction boxes required for the installation
- Luminaire schedule specifying mounting height, circuit, luminaire type, lamp, voltage, wattage, station and offset, and service number
- Identification of existing illumination to remain

The Design-Builder shall submit the Permanent Illumination Plans to the WSDOT Engineer for Review and Comment.

The Preliminary Plan Submittal shall include cross-sections for each light standard installation.

2.16.4.2 **Final Design Submittal**

The Permanent Illumination Final Design Submittal shall be complete, and shall include, at a minimum, the following:

- All items from the Preliminary Illumination Design Submittal
- Existing Utilities
- Proposed channelization
- Light standards as specified, including foundation bases and anchorages
- Electrical wiring schematic for each lighting circuit
- Conduit and conductor schedule showing new wire and existing wire to remain
- Details and notes specifying how new illumination is tied into the existing illumination system
- Transformer schedules
- Sub-panel schedules
- Service cabinet types, as required, including photocells, breaker schedules, and wiring diagrams
- Conduit fill, line loss, and breaker size calculations
- Complete construction notes
- Wire notes (including identification of new and existing conductors and conduit)
- All wire, cable, and terminators that are needed for the complete operation of the lighting system
- Illumination details for non-standard design elements

- All references to the Standard Plans and electrical details
- Structural calculations

2.16.4.3 Released for Construction Illumination Plans

Refer to Sections 2.12, *Project Documentation*, and 2.28, *Quality Management Plan*, for requirements.

2.16.4.4 Working Drawings

Working Drawings and product data shall include, at a minimum, the following:

- Shop drawings for light standards and mast arms for each type and size
- Luminaires and lamps
- Wiring diagrams
- Electrical panels
- Splice enclosures
- Conduit
- Concrete for foundations
- Junction boxes
- Wiring

Refer to Sections 2.28, *Quality Management Plan* for additional requirements.

2.16.4.5 Other Submittals

The Design-Builder shall include the following items upon Physical Completion:

- All documentation including National Transportation Communications for Intelligent Transportation Systems Protocol documentation, test procedures, and test reports
- Software and software documentation
- ***Other deliverables as determined during phase 1***
- List of repair part vendors
- Product manuals

2.16.4.6 Miscellaneous Submittals

At the request of the WSDOT Engineer, the Design-Builder shall deliver to the WSDOT Engineer work-related submittals that do not fit in the previous categories but are prepared in accordance with this Section.

End of Section